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The Secretary of the Navy/Chief of Naval Operations Chair of Oceanographic Sciences

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LONG-TERM GOALS

The overall long-term goals of this work are to facilitate interactions between the academic community and the operating fleet, to accelerate my ongoing research, and to enhance the educational value of my teaching of undergraduate and graduate students.

OBJECTIVES

The overall long-term research objective for this work is to advance understanding and predictive capabilities in three areas:

1) upper ocean physical, bio-optical, and biogeochemical responses to intense wind events including hurricanes and typhoons,
2) coastal optics, physical thermodynamics and dynamics, turbulence, internal gravity waves, sediment transport, and harmful algal blooms, and
3) the physical, bio-optical, and biogeochemical dynamics of ocean mesoscale eddies.

The overall educational objective is to contribute to the development of undergraduate and graduate students, especially those who will seek careers in the ocean sciences.

The overall transitional objective is to stimulate new interactions among academic and Navy laboratory ocean scientists.

APPROACH

The approach for achieving the research goals is to utilize and build upon ongoing interdisciplinary research in the areas of coastal optics and physics, upper ocean response to hurricanes, and mesoscale eddies.

I will be continuing my work on the physical and biogeochemical responses of hurricanes with a graduate student through Chair funding along with other members of my group. We will be utilizing several data sets collected over the past several years from the Bermuda Testbed Mooring (BTM), located off Bermuda near the Bermuda Atlantic Time Series (BATS) site. In addition, we plan to collaborate with observationalists and modelers to better understand the relevant processes and develop improved parameterizations that are needed for better predictive capabilities.

I am the lead PI for the ONR-sponsored Radiance in a Dynamic Ocean (RaDyO) program. A primary goal of RaDyO is to develop models capable of predicting the relationships among several optical properties and environmental factors as well as enabling improved models for imaging applications. In this work, we are studying the propagation of light across the air-sea interface and into and exiting the surface and upper ocean boundary layers. The first field experiment (benign sea-state conditions) is to be conducted in the Santa Barbara Channel in September 2008 and the second field experiment (high sea-state conditions) off Hawaii in August-September 2009. I will be leading both field efforts and coordinating the organization of data, special sessions at meetings, and editing special journal publications for the project.

Finally, mesoscale eddies and their roles in biogeochemical cycling will be studied with another of my graduate students (to funded through the Chair program) and other members of my group. This research will involve data sets collected off Hawaii during the NSF E-FLUX experiment and from the BTM. Again, interdisciplinary modeling of these eddies is a major thrust of the research.

WORK COMPLETED

The Chair funding is expected to begin in late September. However, as indicated above, the research and educational activities relevant to this project are already underway, so that I am hopeful that several results will be reported in the next fiscal year.

IMPACT/APPLICATIONS

Again, since the funding is in the initial stage, there are no impacts or implications directly attributable to this project yet. However, we anticipate several impacts. For example, RaDyO will include the examination of spectral time-dependent oceanic radiance distributions in relation to dynamic surface boundary layer (SBL) processes, construction of a radiance-based SBL model, validation of the model with field observations, and investigation of the feasibility of inverting the model to yield SBL light conditions. These activities bear on understanding and predicting impacts of SBL processes and ocean biogeochemistry and ecology on the underwater light field, and thus operational problems involving naval operations. The feasibility of obtaining ocean surface estimates using underwater camera data will be explored. The work in the areas of upper ocean responses to hurricanes and mesoscale eddies should be valuable for improving predictive models of fundamental oceanographic processes and should be of naval interest.

TRANSITIONS

There are no transitions yet. However, we anticipate that major transitions of will occur in the form of testing and commercialization of new sensors by RaDyO collaborators (e.g., MASCOT). We expect that the RaDyO project will accelerate interdisciplinary ocean measurement technology capabilities by 1) increasing the variety of variables which can be measured autonomously, 2) improving the robustness and reliability of interdisciplinary sampling systems, and 3) reducing adverse biofouling effects on chemical and optical systems. In terms of the hurricane and mesoscale eddy work, transitioning of observational methodologies and predictive model parameterizations is a likely outcome.

RELATED PROJECTS

There are several projects taking place in the Santa Barbara Channel that relate to the RaDyO program. Spatial surface current data (using CODAR) are being collected by Libe Washburn's UCSB group (http://www.icess.ucsb.edu/iog/realtime/index.php) and will be useful for characterizing major current features and passages of sub-mesoscale features and eddies; ship-based bio-optical data collected by the Plumes and Blooms Program (Dave Siegel, lead-PI; http://www.icess.ucsb.edu/PnB/PnB.html) will facilitate interpretation of the RaDyO bio-optical data; surface hydrocarbon slicks and slick dynamics are being investigated (Ira Leifer and Jordan Clark, PIs; http://www.bubbleology.com/); and ship-based data collected by the Santa Barbara Channel Long-Term Ecological Research (LTER; Dan Reed, lead-PI; with focus on land-ocean margin; http://sbc.lternet.edu/) program. Mark Moline of Cal Poly intends to collect physical and optical data in conjunction with the Santa Barbara Channel RaDyO field experiment. Satellite sea surface temperature and ocean color data are being collected by our group, Dave Siegel's group and Ben Holt and Paul DiGiacomo (Jet Propulsion Laboratory, JPL) have been collecting synthetic aperture radar (SAR) data. These remote sensing data sets along with others provide spatial context. By combining and synthesizing these data sets with ours, we will be able to describe and quantify the three-dimensional evolution of several key water quality parameters on time scales of a day to the interannual. Modelers expected to work with us on these data sets include Charles Jones (UCSB), Charles Dong (UCLA), and Yi Chao (JPL).

There are several collaborative efforts that we have already in place for the hurricane/typhoon and mesoscale eddy research planned here. For example, we have been working with Steve Babin (JH/APL), Jerry Wiggert (USM), Maureen Conte (BIOS), and James Carton (U Maryland) on color changes in the wakes of hurricanes. Yi Chao and Fei Chai plan to do model simulations of our hurricane data sets and one of my graduate students will likely focus her efforts in this area. Another of my graduate students will be working with Charles Dong (UCLA) on interdisciplinary mesoscale modeling.

Finally, we plan to facilitate new interactions between the academic community and Navy laboratories. Potential collaborations may be generated with several Navy researchers including Bob Arnone (NRL), John Kindle (NRL), Rick Gould (NRL), Kevin Mahoney (NAVOCEANO), Jeffrey Bowles (NRL), William Snyder (NRL), Bill Shaw (NPS), Thomas Herbers (NPS), Curt Collins (NPS), Jeff Paduan (NPS), Jennifer Prentice (NAVAIR), Karen Patterson (NAVOCEANO).

PUBLICATIONS

No publications yet.

HONORS/AWARDS/PRIZES

Professor Dickey was named a Secretary of the Navy/Chief of Naval Operations Chair in oceanography in 2008.